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HOME & GARDEN INFORMATION CENTER

Why do Foods Need to Be Preserved?

The cost of groceries can be pricey so protecting our purchases against spoilage is a smart economic practice. We know that foods spoil when not handled and stored properly. Not only is food expensive but taking the precautions to prolong quality and maintain safety can be very time consuming. For instance, home food preservers often spend countless hours canning, freezing and drying fresh meats, fruits and vegetables so that they will be edible throughout the year. We know the work is necessary, but why? Have you ever wondered exactly what causes food to go bad?

The three main elements responsible for food spoilage are: naturally occurring enzymes, oxygen and microorganisms. They can work together or independently to ruin foods. The following detailed explanation will help you better understand exactly what causes food spoilage.

- **Enzymes**: Foods begin as living systems. The enzymes that ripen fruits on trees and vegetables on stalks or vines continue to ripen them after harvest. Naturally present enzymes in meats, fish and poultry continue to age them after slaughter. Unless the activities of these enzymes are stopped by heat (blanching, canning or cooking) or slowed by cold, salt, fermentation or another method, they eventually spoil foods by destroying texture, causing browning or other undesirable color changes, changing flavors and decreasing nutritional value.
- **Oxygen**: Air causes undesirable changes. It causes fats to oxidize or become rancid, turns food colors brown and adversely affects nutrients including vitamins. Putting foods in packages, cans or jars limits air. Because air is more soluble in liquids at refrigeration and freezing temperatures, air impermeable packaging is particularly important for foods in cold or freezer storage. Heating food - blanching, canning or cooking - drives out air.
- **Microorganisms**: Microorganisms are so small that they cannot be seen with the naked eye. Three types of microorganisms - bacteria, molds and yeasts – most commonly spoil foods. Some microorganisms – bacteria and viruses - can cause foodborne illness or death. Microorganisms are everywhere; many, including spore-forming bacteria that are difficult to kill, are found in soil and on plants. The scales, skins, feathers and hides of animals carry many microorganisms; many bacteria including several that cause disease (*Campylobacter, Salmonella*, certain *Escherichia coli*) are found in animal intestines. Human skin, hair and intestines carry many bacteria that can contaminate food and cause spoilage or foodborne illness.

For bacteria, molds and yeasts to cause spoilage, the conditions around them must support growth. Bacteria, molds and yeast grow by doubling. One bacterium doubles to produce two, two double to produce four, four double to produce eight, eight double to produce sixteen and so on. Under optimal conditions for growth, a few bacteria can rapidly grow to become millions. The following conditions contribute to an environment in which microorganisms thrive:

1. All microorganisms need **food**.
2. The **acidity** levels of food affect the growth of microorganisms. Most foods are acidic; their acidity levels (as measured by pH) are between 2 and 7. Molds and yeasts grow in foods with a more acid pH (pH of 4.6 or less); these are called acid foods. Spoilage and illness-causing bacteria grow best in foods with a more neutral pH (pH between 4.6 and 7); these are called low acid foods. Lowering pH by fermenting foods or adding acid to them (as in making pickles) limits the growth of spoilage and disease-causing bacteria. Botulism-causing bacteria will not germinate, grow and produce the botulism toxin in foods that have a pH at or below 4.6
3. Bacteria, molds and yeasts need appropriate **temperatures** to grow. Most food spoilage types grow well at temperatures between 40°F and 140°F and quite well at body temperature. Colder temperatures such as found in refrigeration (32°F to 40°F) slow growth of microorganisms; however, some including the disease-causing bacterium *Listeria,* grow slowly at refrigerator temperatures. Freezing temperatures (optimally 0°F or below) halt growth of microorganisms. Heat in the form of blanching, cooking or boiling kills many microorganisms. However, some hardy bacteria like botulism-causing *Clostridium botulinum* form highly resistant spores that survive boiling temperature; destroying its spores requires super-heated steam under pressure at temperatures at or above 240°F.
4. Microorganisms need **time** to grow. Some will double in as few as 20 minutes. Some require longer; some shorter.
5. Many spoilage microorganisms including molds grow best in **oxygen**. Many disease-causing bacteria grow with or without air. The organism that causes botulism (*Clostridium botulinum*) grows best in the absence of air.
6. All microorganisms require **moisture** to grow. In general, molds require less moisture than yeasts and yeasts require less moisture than bacteria. Moisture occurs in foods in two forms – free water that is available to microorganisms for growth and bound water that is not available for growth. Drying, adding salt (curing) or adding sugar (jams, jellies, preserves) are ways to make water unavailable for microorganisms to grow.

The acronym **FATTOM** will help you remember the factors that microorganisms need to grow and spoil foods – food, acidity level, temperature, time, oxygen and moisture. Understanding these factors in addition to the role that enzymes and oxygen play in deteriorating food will help you make good decisions when handling, storing

and preserving food. For practical tips on safe food handling, see HGIC 3490, *Keeping Foods Safe at Home*.

Sources:

1. Andress, E.L. and Harrison, J.A., 2006. "Preserving Food" pp. 5-16. In So Easy to Preserve. 5th ed. Cooperative Extension. The University of Georgia, Athens.
2. The FATTOM acronym came from ServSafe Essentials. 2008. 5th ed. National Restaurant Association.
3. Jay, J.M., Loessner, M.J., and Golden, D.A..2004. Modern Food Microbiology, 7th ed (Food Science Text Series). Springer Press.

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